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MODULATING DEVICE

Filed March 2, 1931

FIG. 1

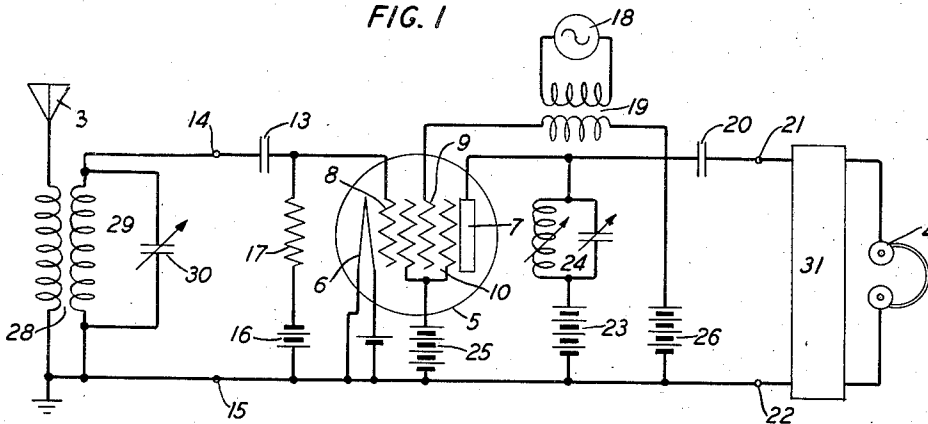
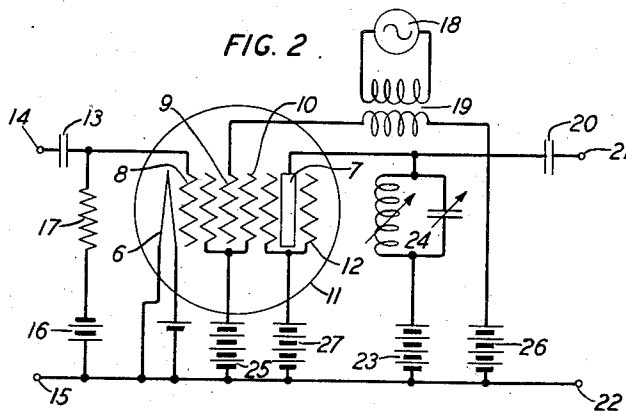


FIG. 2



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MODULATING DEVICE

Application filed March 2, 1931. Serial No. 519,304.

This invention relates to heterodyne detectors and modulators of the space discharge type and more particularly to detector arrangements for use in systems where the heterodyne frequency is maintained relatively close to the frequency of the incoming signals.

In heterodyne detectors generally currents of three different frequencies are involved. These currents represent respectively the incoming signal, the heterodyne oscillation and the detected output or beat frequency current. It is important to be able to adjust the circuits of the detector to control the amplitude of each current without disturbing or changing the amplitude of either of the other currents in so doing. This necessitates substantially independent circuits, one for each frequency.

In accordance with the invention a space discharge device is provided with a cathode, an anode, a plurality of control electrodes and screening members adapted to substantially eliminate direct electrostatic capacity between certain of the electrodes. When this space discharge device is used as a heterodyne detector the incoming signals are impressed upon one control electrode. The local oscillator is connected to another control electrode and the beat frequency or detected current output is taken from the anode. External circuits may be connected to the respective electrodes and adjusted as desired. Changes made in any one circuit will have no material effect upon the currents in the other circuits except in respect of the desired detecting action which the circuit is primarily designed to effect.

The invention will be fully understood from the following specification and the accompanying drawing in which,

Fig. 1 shows a circuit embodying the invention; and

Fig. 2 shows a modification of a portion of the circuit of Fig. 1.

In Fig. 1, an antenna 3 is associated with a telephone receiver 4 through a translating circuit including a space discharge detecting device 5 and its associated circuits. The device 5 includes within an evacuated chamber

a cathode 6, an anode 7, control electrodes or grids 8 and 9, and a screening member 10, partially or wholly surrounding electrode 9. Connections from the cathode 6 and grid 8 are brought out to input terminals 15 and 14, respectively, a suitable biasing potential being applied to this grid by a battery 16 through a grid leak 17. Condenser 13 acts as a stopping condenser for the polarizing battery. A local oscillator 18 is connected through a transformer 19 to the outer grid 9 polarizing potential for which is furnished by battery 26. A connection from the anode is brought out to a coupling condenser 20 and a terminal 21. Another terminal 22 is connected to the cathode. A space current source 23 is connected through a parallel tuned circuit 24 to the anode. The antenna is coupled by means of transformer 28 and a resonant circuit 29 including a tuning condenser 30 to the input terminals 14 and 15 of the detector. Output terminals 21 and 22 are connected through an amplifier 31 to the receiver 4.

The screen 10 surrounding grid 9 is preferably of moderately open mesh forming an effective electrostatic shield between electrode 9 and the other electrodes within the device. The mesh is sufficiently open, however, to allow the passage of a space current through the openings thereof to electrode 9 and anode 7. A positive biasing potential preferably less than the anode potential is supplied to the screen from battery 25.

Fig. 2 shows a modification of that portion of the circuit of Fig. 1 comprised between the terminals 14, 15 and the terminals 21, 22. In this modification, a space discharge device 11 is employed in which an additional screen 12, surrounds the anode 7 and is connected to the cathode 6 through a biasing battery 27.

In the operation of either system received waves amplified by resonance in tuned circuit 29, 30 are impressed upon input terminals 14 and 15 of the detector. The oscillator 18 is adjusted to a frequency which differs from that of the incoming signal by an amount equal to the value of a preassigned beat frequency to which circuit 24 is tuned. The voltage variations of the two grids combine

to produce a component of the desired beat frequency in the space current flowing to the anode 7 which may be supplied to a load circuit such as amplifier 31 and receiver 4, connected between the terminals 21 and 22. The tuning of circuit 24 prevents loss of the beat frequency energy in the anode battery 23, while providing a low impedance shunt for other frequencies.

- 10 When the incoming signal and the local oscillator have frequencies which are relatively high and close together any coupling of the several tuned circuits with one another, such as that due to electrostatic capacity be-
15 tween the detector electrodes, tends to make the adjustment of one circuit affect the tuning of the others and so to make it difficult to adjust the circuit for efficient detection. Such interaction of the circuits is diminished by
20 the isolation afforded by the use of two separate grids, and, by the use in addition of screen 10, or screens 10 and 12, is practically completely eliminated. Due to these provi-
25 sions the oscillator 18 can be adjusted in frequency or amplitude without disturbing the tuning of circuit 29 and the tuning of circuit 24 may be adjusted without affecting either of the other tuned circuits.

30 It will generally be true that the anode current will be more sensitive to changes in the voltage impressed upon the inner grid 8 than it will be to voltage changes impressed upon the outer grid 9. For this reason it will
35 usually be preferable to use the arrangement shown herein in which the incoming signal is impressed upon the inner grid. The lack of sensitivity in the control of the detected current by means of the outer grid 9 may be
40 made up by increasing the power capacity of the oscillator 18 while making most efficient use of the voltage supplied by the impressed signals. Aside from considerations of efficiency it is immaterial in which order the
45 grids are connected.

While the invention has been described in relation to a detecting system in which the frequency of the output current is considerably below the frequency of the input current, the invention may equally well be applied to a modulating device in which the
50 output frequency is higher than the input frequency. The advantages of the arrangement disclosed are not solely dependent upon the particular selection of input and output frequencies employed.

What is claimed is:

1. A heterodyne detector comprising a space discharge device having a cathode, an anode, an inner grid and an outer grid, cir-
60 cuits individual to said anode, inner grid and outer grid respectively, and a screening system interposed between said anode and outer grid and between said outer grid and inner grid, said screening system being positively
65 polarized at a potential intermediate the

anode and cathode potentials whereby electrostatic coupling between every pair of said individual circuits due to interelectrode capacity is substantially eliminated.

2. A heterodyne detector comprising a space discharge device having a cathode, an anode, an inner grid and an outer grid, a circuit for incoming signals connected to said inner grid, a circuit for locally generated oscillations connected to said outer grid, a load circuit for detected currents connected to said anode, and a screening system interposed between said inner grid and outer grid and between said outer grid and anode, said screening system being polarized positively to a potential intermediate the cathode and anode whereby electrostatic coupling be-
75 tween every pair of said connecting circuits due to interelectrode capacity is substantially eliminated.

3. A heterodyne detector comprising a space discharge device having a cathode, an anode, an inner grid and an outer grid, circuits individual to said anode, inner grid and outer grid respectively, a screen interposed between the anode and said outer grid, and a second screen interposed between said inner and outer grids, said screens being positively polarized at potentials intermediate the anode and cathode potentials whereby electrostatic coupling between every pair of said individual circuits due to interelectrode capacity is substantially eliminated.

4. In combination, a space discharge device having a cathode, an anode, an inner grid and an outer grid, input circuits individual to the inner grid and outer grid, respectively, separate sources for supplying oscillations to the respective input circuits, an output circuit responsive to waves representing combination products of the oscillations from said separate sources connected between the anode and cathode, and a screening system interposed between said outer grid and inner grid, said screening system being polarized at a potential more positive than the cathode potential to substantially eliminate electrostatic couplings between said individual inner grid and outer grid circuits due to interelectrode capacity.

5. In combination, a space discharge device having a cathode, an anode, an inner grid and an outer grid, input circuits individual to the inner grid and outer grid, respectively, separate sources for supplying oscillations to the respective input circuits, an output circuit responsive to waves representing combination products of the oscillations from said separate sources connected between the anode and cathode, and a screening system interposed between said outer grid and inner grid, said screening system being positively polarized at a potential intermediate the anode and cathode potentials to substantially eliminate electrostatic coupling between said individ-
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ual inner grid and outer grid circuits due to interelectrode capacity.

6. A heterodyne detector comprising a space discharge device having a cathode, an anode, an inner grid and an outer grid, a circuit for incoming signals connected to said inner grid, a circuit for locally generated oscillations connected to said outer grid, a load circuit for beat frequency oscillations connected to said anode, and a screening system interposed between said inner grid and outer grid, said screening system being polarized positively with respect to the cathode potential and adapted to substantially eliminate electrostatic coupling between the circuits connected to the inner grid and outer grid, respectively, due to interelectrode capacity.

In witness whereof, I hereunto subscribe by name this 26th day of February, 1931.

FREDERICK B. LLEWELLYN.